

APPENDIX B

To

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Final

Fish and Wildlife Coordination Act Report

on the

Arkansas River Navigation Study, Arkansas and Oklahoma

Federally-listed Species

Endangered species that occur within the project area include the fat pocketbook mussel, *Potamilus capax*, pink mucket pearly mussel *Lampsilis abrupta*, scaleshell mussel *Leptodea leptodon*, American burying beetle *Nicrophorus americanus*, pallid sturgeon *Scaphirhynchus albus*, interior least tern *Sterna antillarum athalassos*, whooping crane *Grus americana*, Indiana bat *M. sodalis*, gray bat *Myotis grisescens*, Ozark big-eared bat *Corynorhinus townsendii ingens*, and the Harperella *Ptilimnium nodosum*. The endangered ivory-billed woodpecker *Campephilus principalis*, recently rediscovered at the Cache River National Wildlife Refuge in Arkansas, also occurs in the study area. Threatened species include the Neosho madtom *Noturus placidus*, Arkansas River shiner *Notropis girardi*, Ozark cavefish *Amblyopsis rosae*, bald eagle *Haliaeetus leucocephalus*, piping plover *Charadrius melodus*, *Geocarpon minimum* (no common name), and the western prairie fringed orchid *Platanthera praeclara*. The Neosho mucket *Lampsilis rafinesquana* and the Arkansas darter *Etheostoma cragini*, federal candidate species, also occur within the vicinity of the study area.

We provide a description of all listed and candidate species known to occur in the vicinity of the project below.

Invertebrates: Mussels

Fat pocketbook

The fat pocketbook is an endangered mussel that historically occurred in approximately 200 miles of the St. Francis River system, including the Floodway and associated drainage ditches; the lower Wabash River, Indiana; the mouth of the Cumberland River, Kentucky; and the Mississippi River, Missouri. Over 2,000 individuals were transplanted from the St. Francis Floodway to the Mississippi River by the Missouri Department of Conservation in 1989 to augment that population in an effort to enhance viability. Fresh dead shells have been collected from the Ohio River in Kentucky. The historic records of this species from the Green River, Kentucky, are questionable. The only known viable population of the fat pocketbook is in the St. Francis Floodway, Arkansas.

The greatest impact on the habitat of the fat pocketbook throughout its historic range has been from activities related to navigation and flood control. Channel maintenance dredging has been particularly destructive. Impacts include the loss of stable sandbars and other suitable habitat, increased siltation, and reduced numbers of fish hosts. The upper Mississippi River has been impounded for navigation and is dredged routinely to maintain a 9-foot navigation channel. The fat pocketbook, once widespread in this river, has disappeared in recent years even from areas where other species (including the endangered species *Lampsilis hicioinsi*) continue to exist. The largest populations occur in the St. Francis River and associated ditches. Smaller populations occur in the Ouachita and Little River systems. Within the vicinity of the project, it has been collected near river mile 12 on the White River and downstream on the Mississippi River.

Pink mucket pearly mussel

The pink mucket pearly mussel is an endangered mussel that historically occurred in 25 river systems in 13 states in the eastern United States. The shell of this mussel is thick and smooth with a tan, yellow, or yellowish-brown color. Shells of males are circular in shape while female shells may be nearly square. Faint broad, green rays may cover the shell, but rays are frequently absent from adult shells (Oesch, 1995). This species occurs in medium to large rivers having a medium to strong current over a gravel or sand substrate.

The pink mucket has declined as a result of habitat modification (*e.g.*, dam construction and dredging), water quality degradation, and overharvest by the commercial mussel industry. By 1990, it was known to occur in only 16 river systems, including rivers in Arkansas (Mathews and Moseley, 1990). The largest populations occur in the Spring and White Rivers. Smaller populations occur in the Ouachita and Little River systems. Within the vicinity of the project, it has been collected primarily from the middle and upper portions of the White River (Harris *et al.*, 1997.).

Scaleshell

The endangered scaleshell is a relatively small mussel that possesses a thin, oblong olive-colored shell with faint green wavy rays. The scaleshell occurs in small to medium rivers with stable channels and high water quality. The scaleshell occurs in riffle areas that have a substrate of sand and gravel, where it partially buries itself and siphons the water for food (Oesch, 1995).

This species was historically known from 55 streams in 13 states in the eastern United States. Over the last fifty years the species has declined due to pollution, increased sedimentation (suffocates the mussels and makes feeding difficult), and dams (act as barriers to host fish, isolate populations, and destroy habitat). There are only 13 known scattered populations in the Mississippi River basin in Missouri, Oklahoma, and Arkansas. In Oklahoma, the scaleshell is known from the Kiamichi, Mountain Fork, and Little River systems in the southeastern corner of the state. A single specimen was located in the Poteau River, a tributary to the MKARNS, in Leflore County, but it is unlikely that the species persists in the Poteau River due to habitat modification. Within the study area in Arkansas, the scaleshell is known to occur in two tributaries to the MKARNS: the Fourche LaFave River and Frog Bayou. Living specimens have not been collected at the confluence of the Mississippi with the Arkansas River (Gordon, 1980). Its occurrence within the project area is unlikely.

Neosho mucket

The Neosho mucket, a candidate for federal listing and a state-listed endangered species in Oklahoma, is an endemic freshwater mussel species known to inhabit both large and small river channels in the upper Arkansas River system in southeast Kansas, southwest Missouri, northwest Arkansas, and northeast Oklahoma. Recent status surveys indicate that this species has experienced a drastic decline, possibly as a result of reservoir construction and siltation.

In Oklahoma, the Neosho mucket is currently believed to only occur in the Illinois River, a tributary to the MKARNS, above Lake Tenkiller. Larger concentrations were observed in silty, backwater areas (Mather, 1990; NatureServe, 2003). It has not been located below the reservoir, and is unlikely to occur within the project area.

Invertebrates: Snails

Magazine Mountain Shagreen

The brown to buff-colored threatened snail is known only from one slope in the Ozark National Forest in Arkansas (NatureServe, 2003). The snail requires a cool, moist climate, and is known to move deeper into rock crevices during dry weather. This extremely limited range makes the species particularly vulnerable to extirpation.

Invertebrates: Insects

American burying beetle

The endangered American Burying Beetle (ABB) is a habitat generalist and has been found in a variety of habitat types including grasslands, grazed pasture, bottomland forest, riparian zones, and oak-hickory forest (Creighton et al., 1993; Lomolino and Creighton, 1996; Lomolino et al., 1995; NatureServe Explorer, 2003; U. S. Fish and Wildlife Service, 1991). Populations of the endangered American burying beetle are known to occur within Arkansas and Oklahoma. Suitable habitat for the ABB exists within the project area.

American burying beetles are nocturnal (active only at night) and have a life span of about one year. American burying beetles enter an inactive period underground when the nighttime low temperatures are 60°F or below. This typically occurs from mid-September through late-May in Oklahoma. Once the nighttime low temperatures are consistently (at least 5 consecutive days) above 60°F, ABBs become active. Consequently, the timing of project implementation is crucial to the selection of conservation measures and influences how effectively those measures achieve project goals and compliance with the ESA.

Vertebrates: Fish

Pallid sturgeon

The endangered pallid sturgeon is a large primitive fish with a cartilaginous skeleton and several easily recognizable characteristics: a shovel-like snout, large skates on the head and along the back, and four large fleshy barbells near the ventrally located mouth. The species is restricted to the deep, large channels of the Mississippi-Missouri River system and is considered very rare throughout its range (NatureServe, 2003). Sturgeon inhabit turbid main channels with a strong current over firm sand or gravel. The pallid sturgeon

feeds on insects, crustaceans, mollusks, annelids, other fish, and fish eggs. The pallid sturgeon has drastically declined due to habitat degradation caused by impoundments, channelization, and modified flow regimes. This species also has been adversely affected by over harvesting for their meat and eggs (caviar).

The pallid sturgeon is not currently known to occur in the MKARNS or the White River in Arkansas. Collection records from the Corps Waterways Experiment Station show that this species has been collected from the Mississippi near the confluences of the Arkansas and White Rivers (U. S. Army Corps of Engineers, 2003).

Neosho madtom

The threatened Neosho madtom is a small, short-lived catfish with a mottled appearance and characteristics typical of other catfish (*i.e.*, scaleless skin, a wide head, and barbells). The madtom occurs in large streams with a moderate to strong current. Adults prefer shallow riffles over loosely-packed gravel and pebbles. Young are found in deeper pools (Bulger and Edds, 2001; Natureserve, 2003; Wenke et al., 1992).

Historically, this species occurred in the Neosho, Cottonwood, Spring, and Illinois rivers in Kansas, Missouri, and Oklahoma. The Neosho madtom has been adversely impacted by dredging of gravel, water pollution, an increase in water demand, and by habitat degradation caused by the construction of dams. Impoundments on the Illinois and Grand Rivers in Oklahoma have eliminated about one-third of the former range of this species. Although the Neosho madtom historically occurred in the Illinois River in Oklahoma, it has not been collected from that stream since the construction of Tenkiller Reservoir. The species no longer occurs downstream of reservoirs in the project area that generate hydropower (Grand Lake, lake Hudson, Fort Gibson Reservoir, and Tenkiller Reservoir).

Today, this species is divided into three distinct populations separated by reservoirs: 1) the Cottonwood and Neosho River population above John Redmond Reservoir in Kansas, 2) the Spring River population in Kansas and Missouri, and 3) the Neosho River population below John Redmond Reservoir downstream to the headwaters of Grand Lake in Oklahoma. Thus, within the vicinity of the project, the Neosho madtom persists in the Neosho River above Grand Lake in Ottawa County, Oklahoma (Luttrell, 1991; NatureServe, 2003). Under current operations, portions of the known range are periodically inundated by Grand Lake's flood pool. The more frequently that Grand Lake is in the flood pool, the greater the potential to adversely impact this population of the Neosho madtom (U. S. Fish and Wildlife Service, 1992).

Arkansas River shiner

The Arkansas River shiner is a threatened species native to wide, sandy streams in the Arkansas River drainage in Arkansas, Kansas, New Mexico, Texas, and Oklahoma. Historically, this species would have occurred in the project area. However, the fish has disappeared from over 80% of its former range. The shiner currently is limited to about

500 miles in the Canadian River in Oklahoma, Texas, and New Mexico, and to the Cimarron River in Kansas and Oklahoma.

Threats to the shiner include habitat destruction and modification resulting from the construction of impoundments, stream water depletion due to groundwater pumping and diversion of surface water, and water quality degradation (U. S. Fish and Wildlife Service, 1998). Proposed critical habitat for the shiner includes portions of the Canadian and Cimarron Rivers in Oklahoma (69FR 59859). Eufaula Reservoir is located on the Canadian River at river mile 27.0 downstream of proposed critical habitat.

Ozark cavefish

The threatened Ozark cavefish is one of the most cave adapted vertebrates known. It is a small, blind fish with rudimentary eyes, but no optic nerve. The Ozark cavefish occurs in the waters of limestone solution caves in the Springfield Plateau of the Ozarks in Arkansas, Missouri and Oklahoma.

The Ozark cavefish is extremely sensitive to ground water quality deterioration caused by pesticides and other contaminants within cave recharge areas. Collection by scientists and curiosity seekers also has impacted this species (Willis and Brown, 1985).

The cavefish historically occurred in 24 caves in 9 counties in Oklahoma, Missouri and Arkansas (Brown and Todd, 1987; U. S. Fish and Wildlife Service, 1989). Recent estimates indicate that it is found in 14 caves in 6 counties in the White, Neosho, and Osage River drainage (Willis and Brown, 1985; U. S. Fish and Wildlife Service, 1989). Within the immediate project area, the cavefish occurs in Twin Cave located in Delaware County, Oklahoma near Grand Lake. Water levels in Twin Cave are affected by water levels in Grand Lake, but these fluctuations are not believed to adversely impact the Ozark cavefish (Benham-Holway, 1988; U. S. Fish and Wildlife Service, 1992).

Arkansas darter

The Arkansas darter is a federal candidate species that occurs in the Arkansas River drainage in Missouri, Colorado, Kansas, Arkansas, and Oklahoma. This darter is a small, strongly bi-colored fish (upper half dark brown, lower half white to orange). Within the vicinity of the project, it occurs in northeastern Oklahoma and northwestern Arkansas. This fish inhabits spring-fed creeks and headwaters with abundant herbaceous aquatic vegetation such as watercress *Nasturtium officinale*.

Vertebrates: Birds

Interior Least Tern

The endangered interior least tern inhabits major river systems in the interior United States. Reasons for the decline of this species include anthropomorphic causes (U. S. Fish and Wildlife Service, 1990) such as impoundments and irrigation, overgrowth of

vegetation, the recreational use of sandbars by humans, and flooding of nesting areas caused by unpredictable water discharge patterns below reservoirs (U.S. Fish and Wildlife Service, 1993). Low river flows that result in a land bridge between river islands and the streambank also can adversely impact terns by facilitating predator and human access to nesting sites.

The interior least tern nests on sandbars and sandy islands of major rivers and sandy shorelines of reservoirs. Within the project area, interior least terns forage and nest along the Arkansas River in Oklahoma and Arkansas from April through late August to early September. Terns nest in small colonies and prepare nests by making small scrapes in the sand where two or three eggs are usually laid. Both parents feed the young, which are fairly mobile upon hatching.

Terns prey on small fish, crustaceans, and insects. They prefer to forage in shallow water habitats on small surface schooling fish (2.0 to 9.0 cm long for adults and 1.5 to 4.0 cm long for chicks) (Atwood and Minsky, 1983; Schweitzer and Leslie, Jr., 1996; Wilson et al., 1993). They are considered “surface plungers” (Erickson, 1985) because they hunt for prey while hovering five to ten meters over water bodies, and plunge into the water to capture the fish. Distance to water bodies with available food highly influences reproductive success. Density of surface schooling fish and aquatic vegetation, and water transparency affect the suitability of an area for this species (Schweitzer and Leslie, Jr., 1996).

Interior least terns nest within three main areas in the Oklahoma portion of the study area: 1) the Arkansas River between Kaw Dam and Keystone Lake, 2) the Arkansas River between Keystone Dam and Muskogee, Oklahoma, and 3) the Canadian River between Eufaula Dam and the upper end of Robert S. Kerr Lake. Nesting populations are monitored annually by the Corps, Tulsa District, in accordance with the Service’s Biological Opinion on the effects of the operation of Keystone and Kaw Reservoirs on this species. The Corps, Tulsa District, and the Service update specific management practices and guidelines on a continual basis to account for annual variations in nesting patterns and water management needs.

In Arkansas, nesting locations vary between years depending upon river conditions. Nesting areas observed in 2004 were at river miles 32, 35, 38, 42, 100, 105, 106, 147, 151, 161, 170, 175, 188, 189, 232, 239, and 282. Management practices in Arkansas include restrictions on dredging near nesting areas, notching dikes, and building new islands using dredged material.

Whooping crane

The whooping crane is a tall, mostly white migratory bird with red facial skin. This species utilizes freshwater marshes, wet prairies, shallow lakes, lagoons, salt flats, and grain fields during the summer and during their spring and fall migration period. Whooping cranes occur in coastal marshes, salt flats, and along barrier islands during the winter. They feed on insects, crustaceans, and berries during the summer. During the

winter, their diet consists of grains, insects, crustaceans, mollusks, fish, reptiles, and marine worms (U.S. Fish and Wildlife Service, 1986).

The whooping crane was once widespread over North America. However, it has declined drastically primarily due to 1) the loss of nesting and wintering habitat to agriculture, 2) human disturbance of nesting areas, and 3) uncontrolled hunting. Other causes for their decline include disease, natural events such as storms, and collision with power lines (U. S. Fish and Wildlife Service, 1986; NatureServe, 2003).

Currently, the only self-sustaining population consists of about 200 individuals. This population breeds in one small area in Canada and winters primarily along the Texas coast. These cranes migrate each spring and fall between their breeding and summer grounds primarily through the Great Plains area of the central United States. Their migration route includes western Oklahoma. Salt Plains NWR is a very important stopover area for this population of migrating whooping cranes and is designated critical habitat. The whooping crane is considered a migrant through the study area in the following five Oklahoma counties: Osage, Rogers, Tulsa, Muskogee, and Wagoner.

Bald eagle

The bald eagle was once declining due to pesticide-induced reproductive failure, loss of habitat, and human disturbances such as shooting, poisoning, and trapping, and was originally listed as endangered in 1967. Nationwide, populations have increased due to habitat protection, a reduction in the use of organochlorine pesticides (*e.g.*, use of DDT was banned by the EPA in 1972), and conservation programs. Accordingly, the bald eagle was reclassified as threatened in all 48 conterminous states in 1995. The Service has proposed to remove the bald eagle from the list of Endangered and Threatened Wildlife in the lower 48 states of the United States.

The bald eagle breeds and winters in Oklahoma and Arkansas. Eagles utilize large, mature trees, such as cottonwoods, near rivers and reservoirs for perching and roosting. Trees used for diurnal perching are usually tall, with large diameters and stout branches. Trees used for communal night roosts are usually secluded, and provide protection from adverse weather conditions and human disturbance. Roosting areas are often located near their feeding areas. The eagles along the MKARNS and reservoirs feed mainly on fish, but also may eat waterfowl and carrion.

The MKARNS and associated reservoirs provide suitable habitat for the bald eagle. Eagles are known to occur at each of the 11 Oklahoma reservoirs (and the associated WMAs) that modify flow on the MKARNS. Several of these upstream reservoirs support sizeable concentrations of wintering bald eagles: Keystone, Eufaula, Wister, Grand, Fort Gibson, and Kaw. Bald eagles have used a protected area at Keystone Lake as a communal roost during the winter and spring for over 20 years (U. S. Army Corps of Engineers, 2003). Bald eagles also are known to occur at Sequoyah and Holla Bend NWRs, along the Arkansas River/MKARNS, and at large reservoirs in Arkansas. More

than 1,000 bald eagles are counted in Arkansas each winter. Large numbers occur at Lake Dardanelle and the White River National Wildlife Refuge.

Bald eagles are known to nest at numerous locations within the project area, especially along the main stem of the Arkansas River. Bald eagles have occupied over 30 known nests within the study area in Oklahoma during recent years including below Kaw and Keystone dams and along the Canadian River below Eufaula Reservoir. Numerous nests also are documented from the Arkansas River Valley in Arkansas.

Piping Plover

The piping plover is a small migratory shorebird with a tan back and white belly. The plover has bright yellow legs that distinguish it from similar species. The piping plover breeds from southern Canada to the northeastern and central United States along the Atlantic Coast, on the Northern Great Plains, and around the Great Lakes. Breeding habitat consists of sparsely vegetated, sandy shores of lakes, ponds, and rivers. The plover winters along the southern Atlantic and Gulf coasts, and in the Bahamas and West Indies. Non-breeding habitats include ocean beaches and sand, mud, and algal flats (NatureServe, 2003). Piping plovers use sandy rivers, reservoir beaches and mudflats during migration. Some birds may fly nonstop between breeding and wintering grounds.

Threats to this species are primarily human induced. Drastic declines have occurred due to loss of beach habitat resulting from recreational and commercial development, unfavorable water management, and the modification of riverine habitat through channelization and the construction of dams. The Great Lakes population is endangered. Populations in the northern Great Plains, along the Atlantic and Gulf coasts, in the Bahamas, and west Indies are considered threatened.

The threatened northern Great Plains population migrates through the study area in Oklahoma each spring and fall. They are known to use the Winganon Flats, a shallow water mudflat area at Oologah Reservoir, during their migration (U.S. Fish and Wildlife Service, 1993).

Ivory-billed woodpecker

The ivory-billed woodpecker was recently rediscovered in the Cache River NWR in Arkansas after being presumed extinct for more than 60 years. Following credible sight reports from the NWR, an intensive year long survey for the species resulted in the rediscovery, including feeding marks, and audio and video recordings.

The ivory-billed woodpecker historically occurred in mature, bottomland hardwood forests in the southeastern United States and Cuba. The woodpecker primarily feeds on beetle larvae found beneath the bark of recently dead trees. The usual feeding method consists of the bird using its bill to strip away pieces of bark to locate beetle larvae and tree boring insects (Jackson, 2002).

The ivory-billed woodpecker nests in a cavity in a dead or partly dead tree. No data exists pertaining to the incubation period, but it may be similar to other woodpeckers, which generally have a short incubation period of about 10 – 15 days (Jackson, 2002).

The Department of the Interior has created the “Corridor of Hope Conservation Plan” to save the ivory-billed woodpecker. The "Corridor of Hope" refers to the Big Woods of Arkansas, an area about 120 miles long and up to 20 miles wide in eastern Arkansas where the Ivory-billed woodpecker has been sighted.

The Interior Department, along with the Department of Agriculture, has proposed that more than \$10 million in federal funds be committed to conserve the bird. This amount would supplement \$10 million already committed to research and habitat protection efforts by private sector groups and citizens, an amount expected to grow once news of the rediscovery spreads. Federal funds will be used for research and monitoring, recovery planning and public education. In addition, the funds will be used to enhance law enforcement and conserve habitat through conservation easements, safe-harbor agreements and conservation reserve agreements.

Vertebrates: Mammals

Indiana Bat

The endangered Indiana bat is a grayish-brown migratory bat with blackish brown wing membranes and ears. This bat occurs in the Midwest and the eastern United States. The western edge of the Ozark region in Oklahoma marks the western limit of their range. Indiana bats migrate between winter and summer areas. They hibernate in caves during the winter and occur in wooded areas near streams during the summer. They mate during fall before they enter hibernation while swarming around cave entrances.

Indiana bats require specific temperature and humidity conditions within caves for hibernation. Consequently, the entire species concentrates in only those caves that provide the appropriate conditions for hibernation. While hibernating, they congregate into tight clusters of hundreds or thousands of individuals. Most bats leave their hibernation caves in March and April.

Rivers and streams and their associated vegetated riparian zones and floodplains provide important summer foraging habitat (Humphrey et al., 1977; U. S. Fish and Wildlife Service, 1985). Indiana bats prey on flying insects such as moths, beetles and flies (Humphrey et al., 1977; Black and LaVal, 1985). During summer, maternity colonies roost under tree bark or in hollow trees usually near streams. Males tend to forage over floodplain ridges and hillside forests. They roost in caves (Humphrey et al., 1977; Humphrey, 1978; U.S. Fish and Wildlife Service, 1993).

The Indiana bat has declined primarily due to human disturbances. These disturbances include commercialization of roosting caves, destruction of caves by vandals, disturbance to hibernating bats and pregnant females (disturbances can result in death of hibernating

adults in winter and abortion of young in the summer), and possibly insecticide poisoning. About 87% of the species hibernates in only seven caves. Therefore, the Indiana bat is especially vulnerable to human disturbance during winter (U. S. Fish and Wildlife Service, 1983). Another probable factor in Indiana bat decline is loss of summer habitat such as native forest along waterways (NatureServe, 2003).

The Indiana bat is a migrant through the project area and may occur in riparian and floodplain habitats in the project area during the summer. This species utilizes limestone caves in northern Arkansas and sandstone talus caves south of Lake Wister in the Winding Stair Mountain National Recreation and Wilderness Area, Leflore County, Oklahoma, during the winter hibernation period (Saugey et al., 1990). Summer caves are not known to occur in the project area.

Gray bat

The endangered gray bat is a medium sized bat that occupies a limited geographic range in limestone karst regions of the southeastern United States. Populations are found mainly in Alabama, northern Arkansas, Kentucky, Missouri, and Tennessee. Gray bats also occur in Florida, western Georgia, southeastern Kansas, southern Indiana, southern Illinois, northeastern Mississippi, western Virginia, and northeastern Oklahoma (Barbour and Davis, 1969; Tuttle, 1979).

Gray bats utilize caves year round (Tuttle, 1976). They migrate seasonally between maternity and hibernacula, where mating occurs (U.S. Fish and Wildlife Service, 1993). Only a small percent of the caves within the bat's range provide needed conditions for hibernation (Tuttle, 1979). Consequently, about 95% of the known gray bat population hibernates in only nine caves each winter with more than half utilizing a single cave. Gray bats enter hibernation some time between September and November and emerge in late March or April to migrate to summer caves. Summer caves are typically located within 1 km of lakes and rivers. Undisturbed colonies contain from 5,000 to 250,000 or more bats, while most colonies number between 10,000 and 50,000 bats (Tuttle, 1979).

Gray bats feed on insects almost exclusively over water along reservoir edges and rivers and, to some extent, in adjoining riparian forest canopy during spring and summer. They also use associated forest canopy as a travel corridor and escape route between caves and feeding sites. This behavior provides protection from predators such as owls (U.S. Fish and Wildlife Service, 1982).

The major reasons for the gray bat's decline are human disturbance and habitat or environmental disturbance such as introduction of pesticides, impoundment of waterways, cave commercialization, improper gating, and natural calamities such as cave-ins (Tuttle, 1979). Due to the gray bat's preference for caves near rivers, flooding of caves as a result of man-made impoundments also can be problematic. For example, in summer bats often will move deeper into caves and select areas over water to avoid human disturbance. These areas are more likely to be affected by rising water levels (Tuttle, 1979).

The total gray bat population is estimated at 1,575,000 individuals. Due to conservation measures such as the acquisition of priority caves, many populations are now stable or increasing.

In Oklahoma, gray bats occur in five summer maternity caves in Delaware, Adair, Ottawa, and Cherokee counties. These caves support about 60,000 to 70,000 bats. Known maternity caves are located in close proximity to Tenkiller, Grand, and Fort Gibson reservoirs. Gray bats utilizing these caves likely forage along the reservoir margins, the Illinois and Neosho rivers, and associated streams. These bats migrate to southern Missouri and northern Arkansas to hibernate during the winter.

Ozark big-eared bat

The endangered Ozark big-eared bat is a medium sized, cave dwelling bat with distinctively long ears and facial glands on either side of the face. The bat is endemic to the Ozark region where it inhabits limestone and sandstone caves in oak–hickory Ozark forest (Clark, 1991; U. S. Fish and Wildlife Service, 1995). Ozark big-eared bats often forage in edge habitat between forested and open areas (Clark et al., 1993; Wethington et al., 1996). Their diet consists primarily of moths and other flying insects such as flies and beetles (Clark, 1991).

Caves used by the Ozark big-eared bat occur in a variety of surroundings, ranging from large tracts of contiguous forest to smaller forested tracts adjacent to open areas. Ozark big-eared bats do not migrate. They generally return to the same maternity caves and hibernacula each year. Maternity colonies begin to form in late April to early June (Clark, 1991). Ozark big-eared bats hibernate in locations with high humidity and cold temperatures in areas of total darkness deep within a cave, but they also have been known to occasionally hibernate in twilight areas near the entrance (Clark, 1991; Clark et al., 2002). They usually hibernate in clusters of up to 100 individuals, but also will hibernate in small groups or even singly (Clark et al., 1996).

The vulnerability of the geographically isolated Ozark big-eared bat to extinction is high because of its susceptibility to disturbance. Fragmentation and loss of habitat, vandalism, and increased human activity in maternity roosts and hibernacula have caused population declines (U. S. Fish and Wildlife Service, 1995). Recent counts indicate a population of roughly 1,800 individuals in eastern Oklahoma and about 500 in western Arkansas.

The Ozark big-eared bat was historically found throughout the Ozarks in southern Missouri, Arkansas, and northeastern Oklahoma. However, today this species is found only in Arkansas and Oklahoma (Elliot et al., 1999; U. S. Fish and Wildlife Service, 1995). In Arkansas, the bats are known to primarily occur in Marion, Crawford, and Washington counties. They also occur in Franklin County, and potentially may occur in Benton, Searcy, Logan, Newton, Johnson, and Madison counties. In Oklahoma, Ozark big-eared bats occur in Adair, Delaware, Cherokee, Ottawa, and Sequoyah counties. Caves in Adair County support some of the largest maternity colonies and numbers of

hibernating Ozark big-eared bats. Except for a small portion of Spavinaw Creek, in Delaware County, Oklahoma, Ozark big-eared bat caves are not associated with any major water bodies in the project area.

Plants

Harperella

Harperella is an endangered, annual herb with slender stems, small white flowers, and hollow, quill like leaves. It is known to occur in two habitat types: 1) rocky/gravel shoals of swift, clear streams, and 2) the edges of intermittent pine-land ponds. This species is dependent on a narrow range of hydrologic conditions. Causes for its decline include alterations of water regime from use changes and impoundments, water withdrawal, upstream development, and the draining or deepening of ponds. Harperella is currently known to occur in only 13 extant populations, including populations in Yell and Scott counties, Arkansas (NatureServe, 2003). However, this species is not likely to occur along the MKARNS due to numerous impoundments and the highly modified water regime.

Geocarpon minimum

Geocarpon minimum (no common name) is a small succulent annual plant that is known to only occur at 53 sites in Missouri, Louisiana and Arkansas, including a small population in Franklin County, Arkansas. This threatened species typically occurs on sandstone glades and saline prairies. Typical sites are high in sodium and magnesium and are low in species diversity. This plant completes its entire life cycle within a four week period during spring. Threats include habitat modification, trampling and grazing by livestock, and off-road vehicle use. The species is vulnerable to extirpation due to its limited range and limited available habitat (NatureServe, 2003). Although the species occurs within the project area, it is not likely to be found along the MKARNS.

Western prairie fringed orchid

The threatened western prairie fringed orchid is a perennial herb that produces a tall white inflorescence. It occurs in moist areas in tallgrass prairie or sedge meadows in western portions of the tallgrass region of North America. The orchid once occurred in the vicinity of the project area. However, it has experienced a drastic decline due to conversion of habitat to cropland and pasture, and overgrazing. Currently, extant populations are found from 172 known locations in Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and Manitoba, Canada (NatureServe, 2003; U.S. Fish and Wildlife Service, 1993).

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